XMM-Newton CCF Release Note

XMM-CCF-REL-135

EPIC MOS Spectral Response Distribution

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1   CCF components

Name of CCF	VALDATE	EVALDATE	List of Blocks changed	CAL VERSION	XSCS flag
EMOS1_REDIST_0020.CCF	1999-12-10	2000-07-15	CCD_REDISTRIBUTION-n	3.152	NO
EMOS1_REDIST_0021.CCF	2000-07-15	2000-11-09	CCD_REDISTRIBUTION-n	3.152	NO
EMOS1_REDIST_0022.CCF	2000-11-09	2001-04-18	CCD_REDISTRIBUTION-n	3.152	NO
EMOS1_REDIST_0023.CCF	2001-04-18	2001-08-18	CCD_REDISTRIBUTION-n	3.152	NO
EMOS1_REDIST_0024.CCF	2001-08-18	2001-09-26	CCD_REDISTRIBUTION-n	3.152	NO
EMOS1_REDIST_0025.CCF	2001-09-26	2001-11-25	CCD_REDISTRIBUTION-n	3.152	NO
EMOS1_REDIST_0026.CCF	2001-11-25	-	CCD_REDISTRIBUTION-n	3.152	NO
EMOS2_REDIST_0020.CCF	1999-12-10	2000-07-15	CCD_REDISTRIBUTION-n	3.152	NO
EMOS2_REDIST_0021.CCF	2000-07-15	2000-11-09	CCD_REDISTRIBUTION-n	3.152	NO
EMOS2_REDIST_0022.CCF	2000-11-09	2001-04-18	CCD_REDISTRIBUTION-n	3.152	NO
EMOS2_REDIST_0023.CCF	2001-04-18	2001-08-18	CCD_REDISTRIBUTION-n	3.152	NO
EMOS2_REDIST_0024.CCF	2001-08-18	2001-09-26	CCD_REDISTRIBUTION-n	3.152	NO
EMOS2_REDIST_0025.CCF	2001-09-26	2001-11-25	CCD_REDISTRIBUTION-n	3.152	NO
EMOS2_REDIST_0026.CCF	2001-11-25	-	CCD_REDISTRIBUTION-n	3.152	NO

2   Changes

Two major changes are incorporated in this release. For the first time an observing mode dependency has been introduced in the redistribution parameters to describe the difference between the Timing and Burst mode response and that of the imaging modes. This has been achieved by adding a column called MODE_ID to the CCD_REDISTRIBUTION-n extensions.

The second change is the introduction of an epoch-dependency to describe how the line resolution has deteriorated with time. In this release, the response is given for seven distinct epochs which parallel the CCF for gain and charge transfer inefficiency (CTI), which are the fundamental drivers for the response change.

These changes are only useful in conjunction with the *cal* package version 3.152 or later.
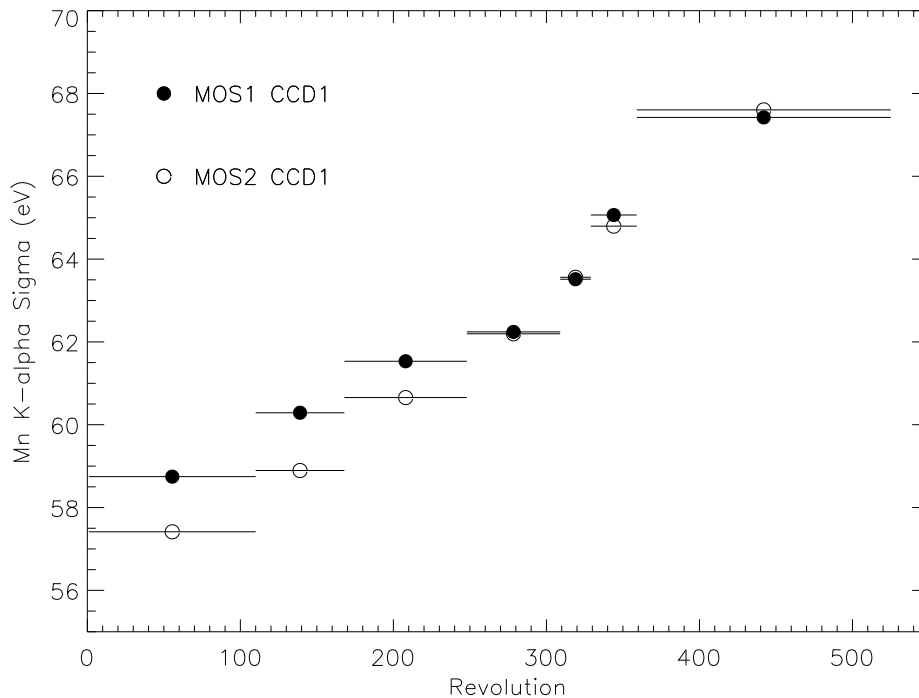
Figure 1: The evolving line resolution of the MOS cameras

3   Scientific Impact of this Update

The separation of the response into different epoch files allows the MOS line widths to be correctly modelled for a given observation date. In previous releases the response has been fixed at the launch value which has given rise to an underestimate of the detector line widths and potentially a false detection of broad lines. Figure 1 shows the changing resolution with time.

Calibrated values for the MOS Timing mode response allows spectra from these observations to be analysed. MOS Burst mode is currently uncalibrated.

4   Estimated Scientific Quality

Two closed-cal observations taken from revolutions 136 and 455 (MOS1, CCD1) have been compared to check the width of the Aluminium K_α line (Fig. 2). Using a response matrix appropriate to revolution 136, a spectral fit correctly returns a narrow line for the first observation but gives an apparent line width of 10 eV for the rev 455 data (Table 1.) If the CCF element, EMOS1_REDIST_0026.CCF, is used to generate the correct response for the revolution 455 observation then the fit shows a narrow, unresolved line as expected.
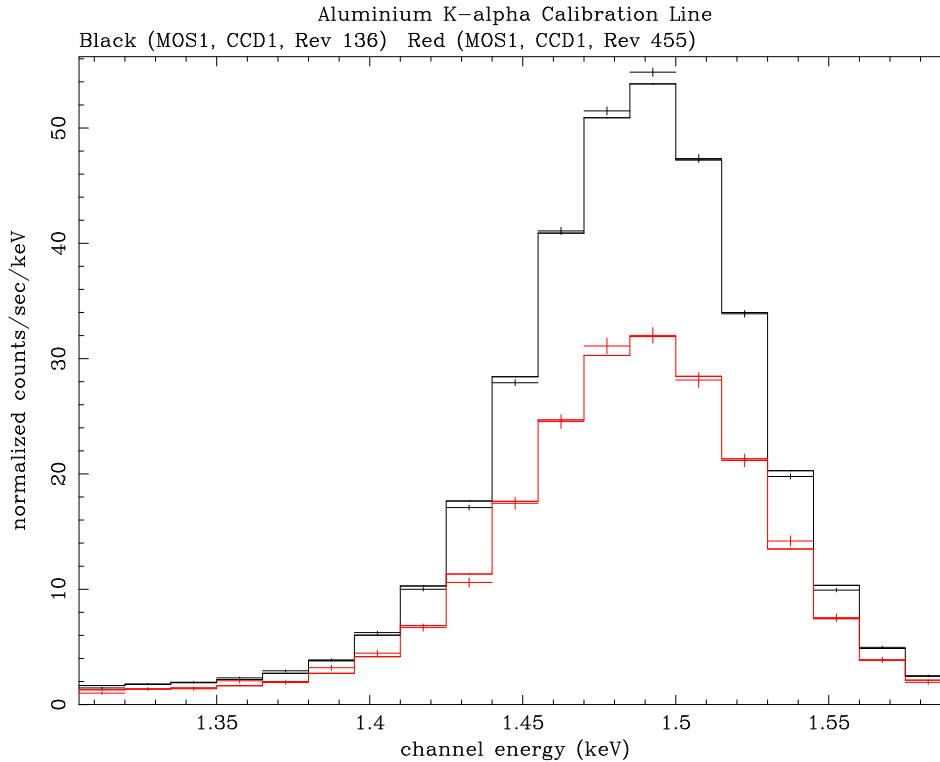
Figure 2: Line spectra from two cal-closed, MOS-1, observations

The line centre energy is seen to be accurate to 3–4 eV at 1.5 keV and the line widths are estimated to be correct to ∼ 3% with this CCF release.

5   Expected Updates

The MOS CCDS have been cooled to improve their performance [1]. This has improved the charge-transfer efficiency and led to a narrowing of the line resolution. A new CCF will be needed to describe the post-cooling epoch for both cameras.

6   Test procedures

The changes introduced here are only used within `rmfgen`. They are designed to allow the SAS to produce RMFs which are equivalent to the LUX canned matrices. Tests will check that they are as similar as possible.

1. Mos-1, epoch 1 (rev 62) imaging mode response, all patterns.
2. Mos-2, epoch 7 (rev 408) imaging mode response, pattern 0 only.

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Table 1: **Spectral fits to the Al-K_α calibration line**

Cal. Obs.[a]	Response[0021][b]		Response[0026][b]	
(revolution)	Energy	Width	Energy	Width
	(keV)	(keV)	Energy	Width
136	1.490 ± 0.001	0.0008 ± 0.0012	-	-
455	1.491 ± 0.001	0.0104 ± 0.0045	1.491 ± 0.001	0.0009 ± 0.0062

[a] The revolution number of the calibration observation.
[b] Spectral fits to the Al calibration line using the response appropriate to revolution 136 (from EMOS1_REDIST_0021.CCF) and the correct response for revolution 455 (from EMOS1_REDIST_0026.CCF).

3. Mos-1, epoch 7 (rev 408) timing mode reponse.

7 Test results

The difference between the MOS standard RMF and the SAS responses generated using these new CCF elements are shown in Figures 3–5. The MOS-1 and MOS-2 responses are duplicated perfectly.

References

[1] Abbey, A.F., Bennie, P.J., Turner, M.J.L., Altieri, B., Rives, S., (in prep.)

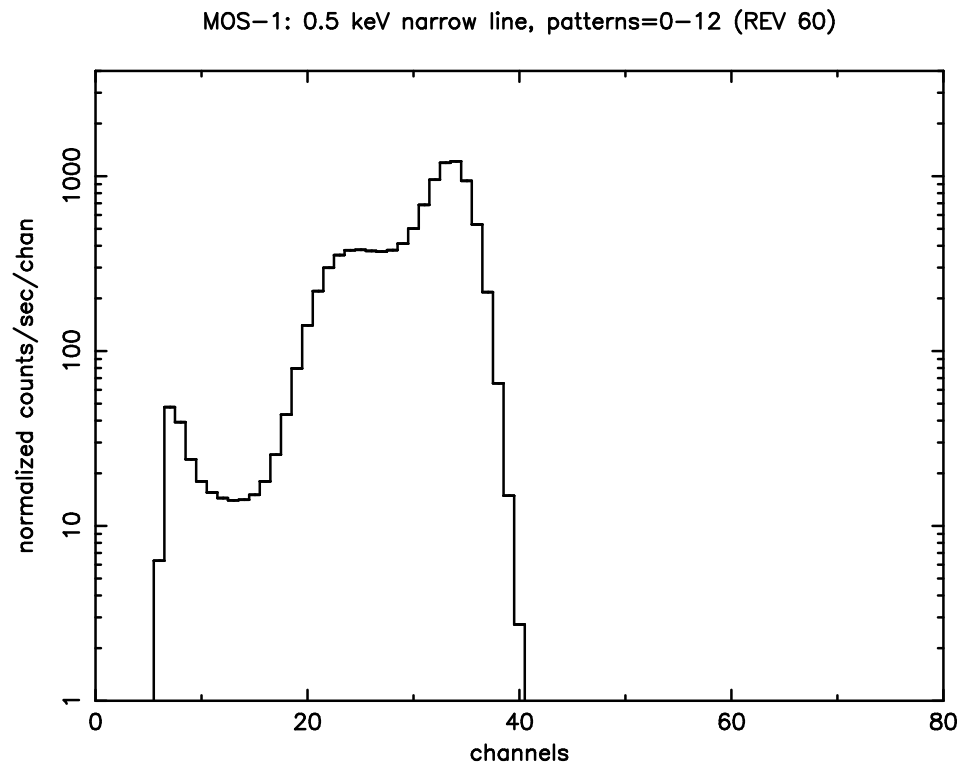MOS−1: 0.5 keV narrow line, patterns=0−12 (REV 60)

Figure 3: Comparison of MOS-1 canned response function v SAS equivalent for a 0.5 keV line from an imaging mode observation of revolution 60, using all patterns.
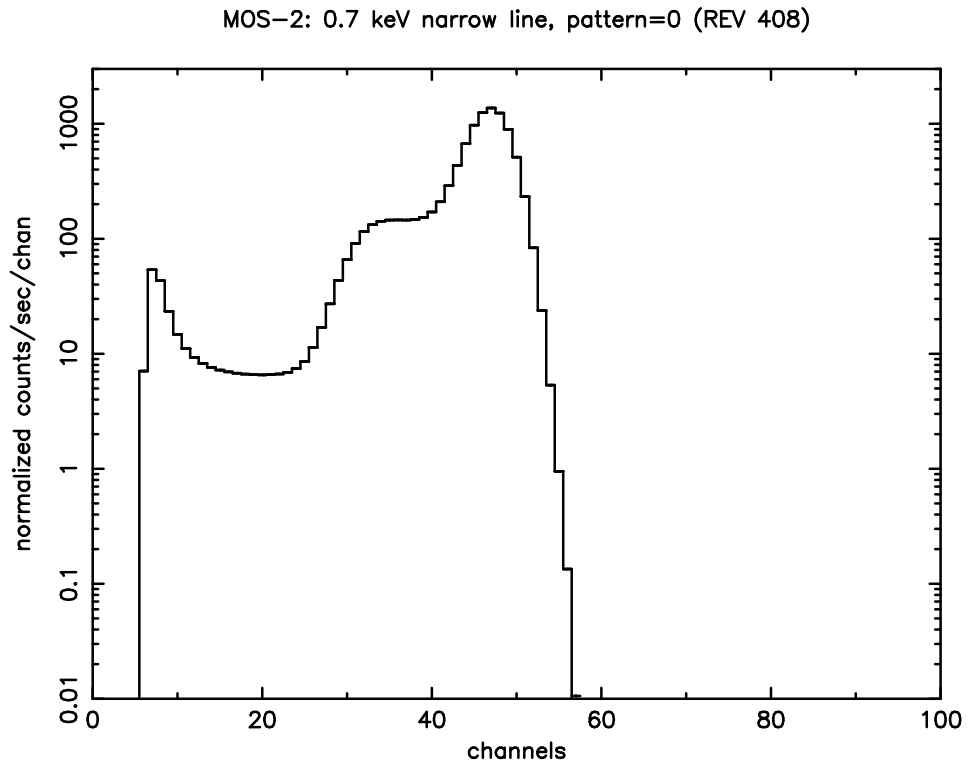
Figure 4: Comparison of MOS-2 canned response function v SAS equivalent for a 0.7 keV line from an imaging mode observation of revolution 408 using pattern 0.
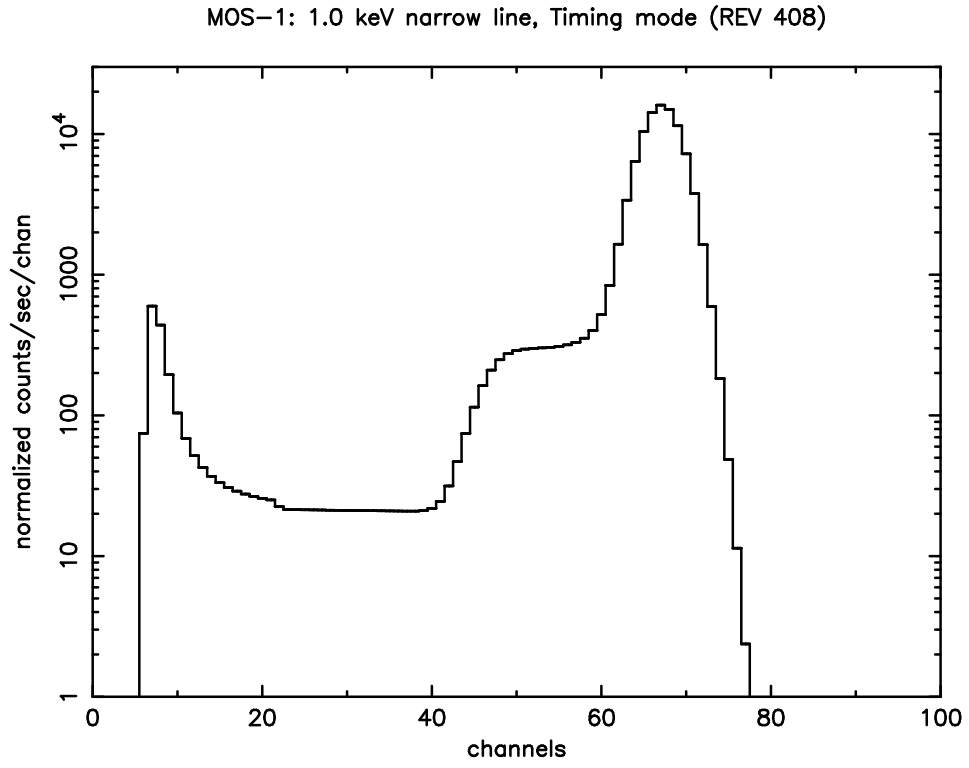
Figure 5: Comparison of MOS-1 canned response function v SAS equivalent for a 1.0 keV line from a timing mode observation of revolution 408.